Other evidence is used to associate the fraction with a particular organelle. The overall procedure supports an inference as to what reactions and enzymes are located in which organelles. However, given the rather violent treatment the material undergoes, one must consider the possibility that it is the violent treatment itself that partly or wholly determines where material ends up. If so, the results are at least in part artifactual and do not provide clear evidence as to where the enzymes originated.

Because centrifugation is inherently a violent and disruptive process, one might wonder whether cell fractionation is exceptional in raising worries about artifacts. In the next section, I will show that many of the concerns target the procedures needed to prepare cells for centrifugation rather than the centrifugation procedure itself. For now it will suffice to indicate that many of the same kinds of issues arose even with electron microscopy, which superficially may seem to be a benign observational technique. The direct act of looking at a micrograph conceals what was done to generate the micrograph in the first place. In their handbook on electron microscopy, Mercer and Birbeck emphasized that in making a micrograph, a researcher is creating something artificial. The challenge is to make something artificial that can be traced sufficiently to the characteristics of the original specimen to support conclusions about that specimen:

> The final micrograph contains elements contributed both by the original object and by the preparative technique applied to it. An important part of the interpretation of the micrograph thus turns on a consideration of these latter factors. There are three distinct successive steps to be considered in the preparation of biological materials for microtomy: fixation, dehydration and embedding. To these may be added a fourth, that of staining, which may however be carried out after sections have been cut. To obviate sterile discussions concerning 'artefacts', the electron microscopists should recognize at once the nature of these operations. Their object *is* the preparation of an artefact of a type which can be examined in the electron microscope, and which bears a sufficiently well-understood relation to some structure originally present in an organism to enable this structure to be deduced from an electron micrograph of the artefact. The interpretation of the micrograph thus rests on an analysis of these steps and requires an understanding of the physical and chemical effects of each. (Mercer & Birbeck, 1972, p. 4–5)[4]

[4] The concern with artifact is not limited to electron micrographs but, as I had occasion to note several times in the previous chapter, was widespread for light microscopy as well. Robert Bensley identified both the reasons for suspecting artifacts and instances in which critics voiced the concern, sometimes in ways that turned out to be correct, sometimes not, in the history of microscopy: "The methods used by cytologists in the preparation of cells for microscopic